

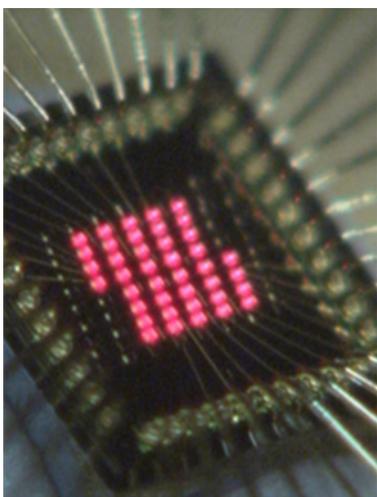
# Fact sheet

## Ricoh VCSEL technology

### Introduction

Conventional commercial printing and mass printing are dominated by offset printers. Digitisation, however, has been under way in this field in recent years, with increased demand for variable printing (personalisation) and liaising with digital image processing.

One result of Ricoh's proactive response to these needs is a newly developed 40-channel vertical cavity surface emitting laser (VCSEL) array.



**Ricoh's 40-channel VCSEL chip**

Ricoh's VCSEL achieves the industry's highest density (4,800 dpi), with the ability to emit 40 laser beams simultaneously as a light source for the optical recording device of a production printer or high-speed copier. This achieves high-speed and high-definition printing equal to that of offset printing, resulting in vivid images and crisp and clean characters/narrow lines.

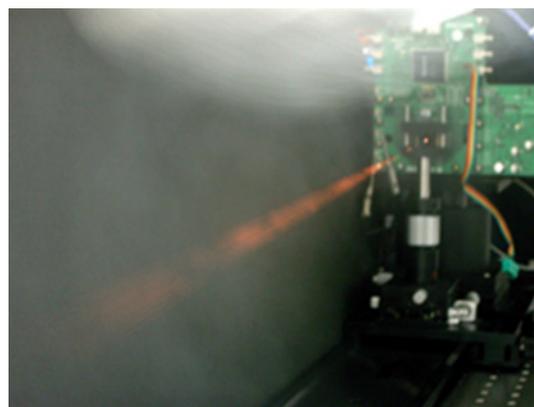
### What is VCSEL?

VCSEL is a surface emitting laser diode that features the fabrication of a two-dimensional arrangement of the beam; density of the laser beam can be significantly increased in a smaller space than with the conventional edge type laser diode. Until recently, VCSEL arrays were difficult to fabricate and therefore commercial VCSEL arrays that satisfied printer specifications were unavailable. Ricoh has successfully overcome those difficulties by developing this original VCSEL designed with a high-quality vertical cavity.

### Ricoh's VCSEL yields 4,800 dpi

This image shows the tire track of all 40 beams emitting from Ricoh's VCSEL. Ricoh developed this 40-beam writing unit—a world first.

With this achievement, Ricoh's printing technology boasts the industry's highest pixel density at 4,800 dpi.



**40-channel VCSEL laser beam—  
the white mist makes the laser beam visible**

### What VCSEL does

The goals of VCSEL research and development were the industry's highest pixel definition, its highest printing speed, and its highest-reliability in obtaining stable image quality. To achieve these goals, Ricoh developed the following additional technologies derived from the 40-channel VCSEL.

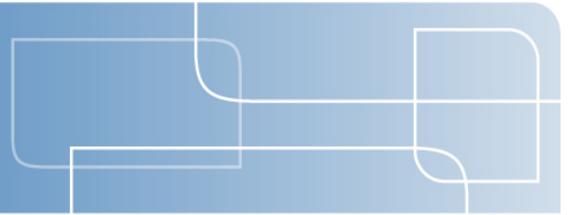
#### High pixel density to improve image quality

One feature of Ricoh's VCSEL is its 40-channel bits arranged in a space of less than 1 mm<sup>2</sup>. An original VCSEL driver was developed to expand the 40 beams to the industry's highest density pixels on paper. This driver sharply improves response in optical output, and slanted narrow lines and isolated dots excel in image reproducibility. The driver chip is placed beside the VCSEL chip and controls the 40 beams individually by high-speed modulation.

#### High-speed printing

To gain high printing speed, a high power writing unit with high quality optical beams was required. In developing the VCSEL, to satisfy this requirement, Ricoh developed an original active layer and optical filter layer for the 40-channel VCSEL.

# Ricoh's VCSEL printing technology boasts the industry's highest pixel density (4,800 dpi).



An active layer with high efficiency and improved thermal conductivity was created using a new material with low thermal resistance. And high optical quality was achieved using an original new filter, which suppresses higher modes. As a result, Ricoh's VCSEL leads the industry with the highest output power with high quality optical beams.

## Stable image quality during printing

To ensure high-quality printing of images, stability of the light source is an important characteristic of the writing unit. Ricoh's VCSEL achieves long-time beam stability, long-life, and good element robustness by employing newly developed process technologies and a highly thermal conductive structure.

## Benefits of VCSEL

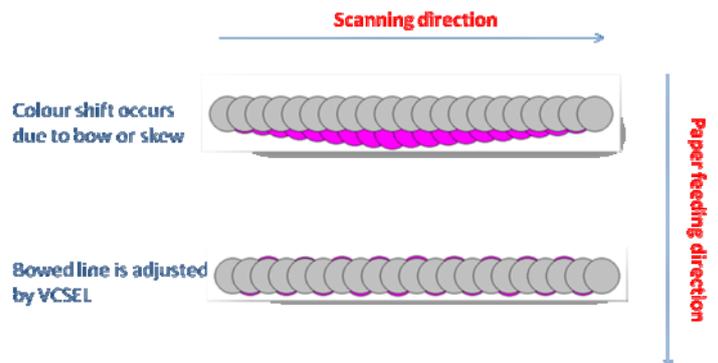
VCSEL consists of several image correction technologies that provide benefits such as high speed colour printing at a resolution of 1,200 x 4,800 dpi and automatically reduce registration and colour shift errors, which are typical when printing at higher resolutions. The 40-channel VCSEL array has a number of advantages compared with conventional edge-emitting lasers:

- ✓ VCSEL operation uses only a tenth of the power consumed by conventional edge emitting lasers
- ✓ VCSEL emits 40 beams in two directions to produce a maximum image resolution of 1,200 x 4,800 dpi—enabling these devices to write data at high speed and at a higher resolution
- ✓ When printing duplex, some types of paper can shrink or enlarge after the front page goes through the fusing unit. This change in paper size can result in inaccurate registration on the front and back pages. VCSEL applies two kinds of correction technologies to prevent this issue:

**Magnification correction**—image magnification adjustment on the back page can be set by a user. This is a function of the Paper Library. A user can make a precise adjustment (1 dot=5µm) to the back page to align front and back page registration

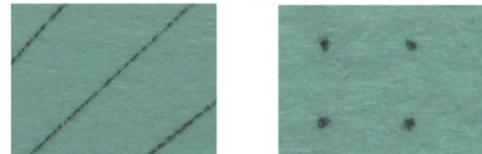
**Pixel clock frequency**—the image can be adjusted by inserting or removing 1/48 dot size to avoid a mismatch between the front and back page registration

- ✓ Colour shift issues can occur due to bowed or skewed lines when printing at higher resolutions. These are usually caused by the optical system, and are automatically corrected by adjusting the laser beam in the direction that paper is being fed.



- ✓ To ensure high quality printing of images, stability of the light source is crucial. VCSEL achieves constant beam stability using optical waveform correction by monitoring and controlling the volume of power supplied. This correction is especially effective when printing thin diagonal lines.

## Without optical waveform correction



## With optical waveform correction



VCSEL technology is integrated into Ricoh's GWNX controller and is available on the latest production printers and MFPs. For information about Ricoh devices that support VCSEL technology, contact your local sales company and explore the *Sales Knowledge Centre* website.

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